CHAPTER-2: LITERATURE REVIEW

A mixed formulation of finite element are presented [4] for spatial beams. For finite rotations and transverse shear strains the basic kinematic assumption is taken. A derivation with the Green–Lagrangean strains and the beam strains is formed. By using kinematic equations, static field equations and the constitutive equations three-field variational formulation is formed. With the Euler–Lagrange equations the zero value is taken for higher order stress resultants. For rectangular cross sections the formulation is prohibited in this paper. The beam strains interpolation can be divided into two parts. The stress resultant interpolation is identical for the first part. The cross section warping is described in the second part and transverse normal strains are also allowed. The realization of arbitrary three-dimensional constitutive laws can be easily understand by using this approach. To find out a locking free element formulation, in the length direction of the beam element, full Gauss integration method is used. By the examples of several numerical the effectiveness of the method can be analyzed. The method is best suitable to calculate the load bearing capacity of the spatial beam structures. Very large load steps can be taken as compared to other element formulations.

For static and vibration analysis, multivariable hierarchical beam element formulations is presented [9] in which two kind of variables is taken and the analysis is based on the generalized variation principle. For the generalized force field functions and displacement functions, shifted Legendre hierarchical polynomials two forms will be used which will easily compute or calculate the relevant matrices. generalized variational principle in which variables of two kinds are taken is used for the derivation of the displacement and generalized force field functions, the whole formulation is done by the multi variable hierarchical beam element. In conventional displacement to find out the differential operations which is based on the FEM is not required because high accuracy is achieved in the present method and the same method can also be easily used for plates or shells..

For the equal strength rotating Timoshenko beams in case of transverse vibrations [19] a new finite element is formulated which depends upon the coupled displacement field and the tapering functions of the beam. Coupling of the transverse displacement and cross-sectional rotation for polynomial coefficients is done by the differential equations of equilibrium in case of coupled
displacement field. In the longitudinal direction of the beam principle of equal strength is used to obtain the tapering functions of breadth and depth of the beam. The kinetic energy and strain equations are used to express the stiffness and mass matrices after obtaining the displacement functions. For the evaluation of the new model, in Mathematica semi-symbolic computer program is generated. The paper example is solved and then the calculated result is compared with the result obtained from models developed in the ABAQUS. Then it gives a good result of the new model and other model.

For providing a highly ductile response and reliable performance, development of RBS moment-resisting connections [23] has been done. The designing and detailing recommendations for RBS member has given in Part 3, EC8. From European research the existing data is limited so the efficiency of the recommendations for the same is dubious. To calculate the result of the geometrical characteristics of the RBS, development of an experimental program is done and the result shows in paper. Under the cyclic loading the testing of two full-scale sub assemblages is done and then the result which is obtained by using the concept of FEM is compared with this result. Geometrical characteristics readjustment of the RBS is required for applying to European profiles.

For the three-dimensional nonlinear finite element analysis of inflatable beams this paper was presented. Modern textile materials are used for making this beam [44] under consideration and when inflated these beams can be used as a load-bearing beams or arches. With a homogeneous orthotropic woven fabric (OWF) 3D Timoshenko beam was proposed. From the inflation pressure the follower force is produced. Total Lagrangian form of the virtual work principle to perform the nonlinear equilibrium equations which were discretized by the finite element method. Then investigated Two kinds of solutions: finite elements solutions for linearized problems and nonlinear finite element solutions. For example, there is a cantilever inflated beam bending problem subjected to concentrated load was considered and existing theoretical models is improved by the deflection results. Fabric are used for making these beams, With a 3D thin-shell finite element model these beam models were compared. Through a parametric study influence of the material effective properties and the inflation pressure on the beam was also investigated. for linearized problems the finite elements solutions were found very close to the theoretical results existing in the literature. On the other hand, The results for the linearized finite
elements model in the case of high mechanical properties is very close to the results for the nonlinear finite element model. For functionally graded material which is used as core material, free vibration analysis of sandwich beams is done. To solve the elasticity problems of two dimensional [56] the element free Galerkin method and Galerkin formulation is used. For modeling of interface between the core occurs in the sandwich beam and the face sheets Penalty method is used. The derivation of elastic core is done due to the similarity of materials in the face sandwich beam. It result is so good as get in the result calculated by the FEM. With functionally graded core, sandwich beam natural frequencies is obtained and discussed.

The static analysis of smart beams by using two finite elements [57] with piezoelectric sensors/actuators is presented in this paper and the elements used in this analysis are adhoc smart beam element (ADSBE) and variational asymptotic smart beam element (VASBE). The results of both the elements will depend on the cross-sectional matrices computation which is joined or subjected with the electromechanical properties of cross-section the beam. ADSBE uses the Timoshenko cross-sectional stiffness matrix is used by adhoc smart beam element and calculated computed by the variational asymptotic smart beam element program, and across the thickness of each piezoelectric layer, assumption is taken that electric field is constant. A numerical integration method using the VABS program is used for taking the benefits of the discretized cross-section of the beam, all the electric field related matrices are also calculated. For smart beams construction fully coupled Timoshenko theory is used which is used the variational asymptotic method on which VASBE will depend. A two-dimensional electromechanical cross-sectional analysis and a one-dimensional beam analysis is decoupled by the original three-dimensional electromechanical problem by using this theory. For the validity of the accuracy of these two new elements several types of examples can be found in the literature. By using adhoc smart beam element and variational asymptotic smart beam element the numerical results is obtained and these results are correlated well with other published results. That are out of the limits structures structure may be modeled as a beam, the adhoc smart beam element presents considerable errors and, therefore, should not be used. Variational asymptotic smart beam element can show the error less than 8% for the prediction of the 3D results.

With partial shear interaction (PI), composite steel–concrete beam-columns analysis [61] is done for stiffness formulation. On the direct stiffness method (DSM), this formulation [61] depends.
In this method when the element derivation is done then approximated displacement and/or force fields are involved or taken like other method or modeling techniques and this is the advantage of this method. Structural elements like simply supported beams and propped cantilevers is taken on which point load and uniformly distributed load is applied then such type of problems is solved to check the accuracy. To reduce the curvature locking problem which is analyzed by the some conventional displacement formulations, this method is used for shear connection stiffness different levels whose aim is to highlight the ability of the proposed method. The main application of this method to highlight the ability of the material at both ultimate conditions and service.

In urban environments, the effects of the surface ground movements can be analyzed which may cause of structural damage on nearby buildings due to construction of shallow tunnels. A mesh of elastic Timoshenko beams is generated on the building footprint is developed to understand the behavior of structural behavior of the building for which 3D model [64] is developed. Soil/structure interaction effects is involved in this model, on the ground surface the detailed modelling of any buildings is unnecessary.

Due to the superior performance, Preflex beam [73] is widely used in construction of highway and railroad bridges which is a prestressed composite beam. The manufacturing of the Preflex beam is done in such a way that under preflexion loads, I-shaped steel plate-girder is bent and in its tensile flange, high-strength concrete is cast. When the concrete achieves its full strength or hardens in seven or eight days later, the loads are removed and in casing concrete of tensile flange compressive prestresses are introduced due to which the beam regains a measure of its original shape. By transporting the preflex beam to the site The whole structure is completed and the placement of the preflex beam will totally depend upon the situation of the site.

The paper presents that in sandwich beams for the analysis of global and local instability a novel finite element [92] is used. For the finite element analysis one-dimensional (1D) element is considered in which layer-wise higher-order transversal displacements is taken for the beam thickness variation. In sandwich beams it captures local effects (e.g., wrinkling)by using only 1D modeling. To solve the obtained nonlinear equations, asymptotic numerical method in the combination of FE modeling is used. The are compared to the resulting from the The critical loads obtained by the analytical and the 2D finite element calculations is used to compare the
predicted critical loads developed from the 1D FE model and then agreements of better quality are found.

Through the thickness which is based on the power law, functionally graded beam dynamic characteristics is presented with material graduation is presented in this paper [94]. By axially or transversally uniform geometrical graded beam the non-uniform geometrical beam can be replaced which is a more effective model. The assumptions of the Euler–Bernoulli beam theory is taken and by using the virtual work principle, the equations of motion of the system is derived. For obtaining the motion equation numerical approximation and to discretized or divided the model finite element method (FEM) is used. This model has been approved for giving the better result in previous work. On the dynamic characteristics of the beam to highlight the effect of the slenderness ratios, different material distribution and boundary conditions numerical results are presented in graphical forms and tabular form.

On the dynamic behavior of the beam all these effects plays a important role.